

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-038955

(43)Date of publication of application : 06.02.2002

(51)Int.Cl. F02B 23/02  
 F02B 1/12  
 F02B 43/00  
 F02D 19/02  
 F02D 19/10  
 F02D 19/12  
 F02D 41/02  
 F02D 41/38  
 F02M 21/02  
 F02M 37/00

(21)Application number : 2000-221824 (71)Applicant : NISSAN DIESEL MOTOR CO LTD

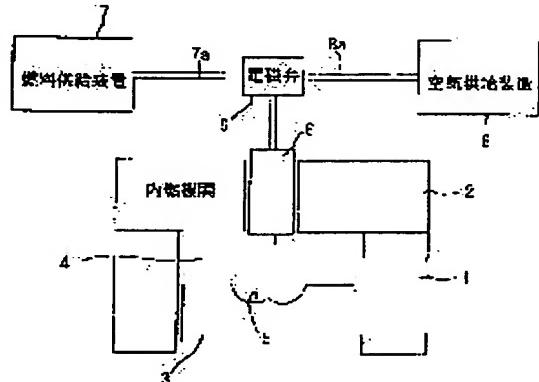
(22)Date of filing : 24.07.2000 (72)Inventor : HONJO FUMITAKA

## (54) CYLINDER INJECTION TYPE ENGINE

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To effectively promote mixing of injection fuel with air in also a cylinder injection type engine performing compression ignition by using gas weak in penetrating force for fuel.

**SOLUTION:** A supply device 8 for high pressure fluid (air) is provided, an injector 6 is connected with a supply passage 7a for fuel and a supply passage 8a for high pressure fluid in parallel, and a means 9 for opening/closing the supply passages 7a and 8a according to a crank angle is provided.



## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other

than the examiner's decision of rejection or  
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's  
decision of rejection]

[Date of requesting appeal against  
examiner's decision of rejection]

[Date of extinction of right]

**\* NOTICES \***

**JPO and NCIPPI are not responsible for any damages caused by the use of this translation.**

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

**CLAIMS**

---

**[Claim(s)]**

[Claim 1] The injection type engine in a cylinder characterized by forming the injector which injects air or combustible gas to the injection fuel of a combustion chamber in the injection type engine in a cylinder equipped with the injector of a fuel.

[Claim 2] The injection type engine in a cylinder characterized by forming the injector which injects inert gas in a combustion chamber in the injection type engine in a cylinder equipped with the injector of a fuel.

[Claim 3] The injection type engine in a cylinder characterized by establishing a means to open and close these supply paths according to a crank angle while preparing the feeder of a high-pressure fluid and connecting the supply path of a fuel, and the supply path of a high-pressure fluid to one injector in juxtaposition in the injection type engine in a cylinder equipped with the injector of a fuel.

[Claim 4] The injection type engine in a cylinder according to claim 3 characterized by using air or combustible gas as a high-pressure fluid.

[Claim 5] The injection type engine in a cylinder according to claim 3 characterized by using inert gas as a high-pressure fluid.

[Claim 6] The injection type engine in a cylinder characterized by to establish a means open and close these supply paths according to a crank angle while forming the equipment which supplies individually the high-pressure fluid with which plurality differs in the injection type engine in a cylinder equipped with the injector of a fuel and connecting with the supply path of a fuel in juxtaposition each supply path of a high-pressure fluid which is different in one injector.

[Claim 7] The injection type engine in a cylinder according to claim 6 characterized by using air or combustible gas, and inert gas as a high-pressure fluid with which plurality differs.

---

[Translation done.]

**\* NOTICES \***

**JPO and NCIP are not responsible for any damages caused by the use of this translation.**

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

**DETAILED DESCRIPTION**

---

**[Detailed Description of the Invention]**

[0001]

[Field of the Invention] This invention relates to the injection type engine in a cylinder equipped with the injection valve of a fuel.

[0002]

[Description of the Prior Art] In the injection type engine in a cylinder which performs jump spark ignition, there are some which arranged the injection valve for stratification combustion (injector) and the injection valve for homogeneity combustion from the relation between an ignition plug or squish area to the combustion chamber (arrangement) (JP,7-247841,A). Moreover, in order to extend the possible operating range of stratification combustion in the injection type engine in a cylinder which performs jump spark ignition, While preparing the injection valve of the fuel arranged at the side attachment wall by the side of the inlet valve of a combustion chamber, and the injection valve of the high-pressure air arranged by the side attachment wall by the side of the exhaust valve which counters this There are some which formed in the piston-top surface the guide slot shown so that it may collide in the lower part of an ignition plug located in the center section of the combustion chamber, suppressing that such fuel spray and high-pressure air to inject diffuse to a perimeter (JP,10-331642,A).

[0003]

[Problem(s) to be Solved by the Invention] In the injection type engine in a cylinder, when performing compression ignition, if injection pressure of a fuel is not set up highly fairly, an injection fuel will not be spread in a combustion chamber, but it will come to light near a compression top dead center, but since mixing with air is not enough, the fault of being easy to cause aggravation of engine loss of power or exhaust air emission (HC, CO, etc.) can be considered. When especially a fuel is gas (for example, CNG), the accomplishment force of colliding with the piston-top surface of an injection fuel etc. is weak, and an injection fuel tends to solidify deeply in a part of combustion chamber.

[0004] This invention aims at offer of the effective cure means for improving such a trouble.

[0005]

[Means for Solving the Problem] In the 1st invention, it is characterized by forming the injector which injects air or combustible gas to the injection fuel of a combustion chamber in the injection type engine in a cylinder equipped with the injector of a fuel.

[0006] In the 2nd invention, it is characterized by forming the injector which injects inert gas in a combustion chamber in the injection type engine in a cylinder equipped with the injector of a fuel.

[0007] In the 3rd invention, in the injection type engine in a cylinder equipped with the injector of a fuel, while preparing the feeder of a high-pressure fluid and connecting the supply path of a fuel, and the supply path of a high-pressure fluid to one injector in juxtaposition, it is characterized by establishing a means to open and close these supply paths according to a crank angle.

[0008] In the 4th invention, it is characterized by using air or combustible gas as a high-pressure fluid in the 3rd invention.

[0009] In the 5th invention, it is characterized by using inert gas as a high-pressure fluid in the 3rd invention.

[0010] In the 6th invention, in the injection type engine in a cylinder equipped with the injector of a

fuel, while forming the equipment which supplies individually the high-pressure fluid with which plurality differs and connecting with the supply path of a fuel in juxtaposition each supply path of a high-pressure fluid which is different in one injector, it is characterized by establishing a means to open and close these supply paths according to a crank angle.

[0011] In the 7th invention, it is characterized by using air or combustible gas, and inert gas as a high-pressure fluid in the 6th invention with which plurality differs.

[0012]

[Effect of the Invention] In the 1st invention, since the injection fuel of a combustion chamber is agitated by injection of air or combustible gas and mixing with a fuel and air is promoted, also in the engine with which a fuel performs compression ignition using the weak gas of the accomplishment force, the improvement in engine power and reduction of HC and CO are obtained. Moreover, in the case of combustible gas, propagation of a flame is also promoted.

[0013] In the 2nd invention, if inert gas is injected to the injection fuel of a combustion chamber, since the injection fuel of a combustion chamber will be agitated by injection of inert gas and mixing with a fuel and air will be promoted, also in the engine with which a fuel performs compression ignition using the weak gas of the accomplishment force, the improvement in engine power and reduction of HC and CO are obtained. If inert gas is injected like the inhalation-of-air line before fuel injection, in order for air to decrease comparatively (oxygen density), a combustion maximum temperature is stopped low and generating of NOx is also reduced.

[0014] In the 3rd invention, a high-pressure fluid besides a fuel can be injected with one injector. If a high-pressure fluid is injected to the injection fuel of a combustion chamber, since an injection fuel will be agitated by injection of a high-pressure fluid and mixing with air will be promoted, also in the engine with which a fuel performs compression ignition using the weak gas of the accomplishment force, the improvement in engine power and reduction of HC and CO are obtained.

[0015] In the 4th invention, if high-pressure air or combustible gas is injected by the injection fuel of a combustion chamber, since mixing with a fuel and air is promoted by churning operation of the injection, also in the engine with which a fuel performs compression ignition using the weak gas of the accomplishment force, the improvement in engine power and reduction of HC and CO will be obtained according to it. Propagation of a flame is also promoted when based on injection of combustible gas.

[0016] In the 5th invention, if inert gas is injected by the injection fuel of a combustion chamber, since the injection fuel of a combustion chamber will be agitated by injection of inert gas and mixing with a fuel and air will be promoted, also in the engine with which a fuel performs compression ignition using the weak gas of the accomplishment force, the improvement in engine power and reduction of HC and CO are obtained. If inert gas is injected like the inhalation-of-air line before fuel injection, in order for air to decrease comparatively (oxygen density), a combustion maximum temperature is stopped low and generating of NOx is also reduced.

[0017] In the 6th invention, the high-pressure fluid with which plurality besides a fuel is different can be injected by one injection valve. If the high-pressure fluid injected after fuel injection and the high-pressure fluid injected before fuel injection are set up, while mixing with a fuel and air will be promoted with the high-pressure fluid injected after fuel injection, the ambient atmosphere of the combustion chamber which suits operational status is acquired with the high-pressure fluid injected before fuel injection.

[0018] In the 7th invention, if air or combustible gas is injected after fuel injection, since mixing with a fuel and air is promoted by churning operation of the injection, also in the engine with which a fuel performs compression ignition using the weak gas of the accomplishment force, the improvement in engine power and reduction of HC and CO will be obtained according to it. If inert gas is injected like the inhalation-of-air line before fuel injection, in order for air to decrease comparatively (oxygen density), a combustion maximum temperature is stopped low and generating of NOx is also reduced.

[0019]

[Embodiment of the Invention] Drawing 1 expresses the operation gestalt to the injection type engine in a cylinder which performs compression ignition, and 1 shows the piston from which a cylinder block and 2 constitute the cylinder head with these, and 3 constitutes a combustion chamber 4. It

becomes depressed in the abbreviation center section of piston 3 top face, the section 5 (cavity) is formed, the nozzle hole at a tip is turned to the cylinder head 2 to a cavity 5, and an injector 6 (injection valve) is arranged.

[0020] 7 is a fuel supply system which supplies high-pressure fuel gas (CNG) to an injector 6, and it has air supply equipment 8 which supplies high-pressure air to an injector 6 in this engine. Supply path 8a of air is connected to an injector 6 in juxtaposition with supply path 7a of a fuel, and the solenoid valve 9 which opens and closes these supply paths 7a and 8a is infix.

[0021] it is alike and a solenoid valve 9 is controlled so that fuel gas is injected from an injector 6 at the predetermined period (fuel fuel injection period) of a compression stroke, and air is injected from an injector 6 at the predetermined period after fuel injection (air-injection period) (drawing 5, reference). Therefore, although not illustrated, it has a means to detect an engine crank angle, a means to control the change of a solenoid valve 9 based on this detecting signal, and \*\*. In addition, although illustrated on an injector 6 and another object for convenience, a solenoid valve 9 is installed inside the \*\*\*\* nearness of a nozzle hole in the interior of an injector 6 in order to stop the residue of fuel gas and air to the minimum.

[0022] According to an engine crank angle, fuel gas is injected by the fuel fuel injection period from an injector 6 at the inhalation air of a combustion chamber 4, and air is injected from an injector 6 by such configuration at an air-injection period. Although the fuel gas injected from an injector 6 has the weak accomplishment force of colliding with piston 3 top face and it is easy to solidify in the center section of the combustion chamber 4 deeply like drawing 2, since air is injected by the lump of this fuel gas from an injector 6, mixing with fuel gas and air is efficiently promoted by churning operation of that air injection like drawing 3. Therefore, good diffusive burning comes to be obtained and improvement in engine power and reduction of HC and CO can be aimed at.

[0023] In air supply equipment 8, if high-pressure combustible gas is supplied instead of air at an injector 6, mixing with fuel gas and air will be promoted by injection of combustible gas, and compression ignition and its flame propagation will also be promoted. If a high-pressure liquid (it has inflammability) is used, injection of a liquid will become the accomplishment force of spraying is strong and possible [ heightening effectiveness as stated above further ].

[0024] If inert gas is injected in the lump of fuel gas when using inert gas instead of air, mixing with fuel gas and air will be promoted by churning operation of the injection. Moreover, if inert gas is injected to the combustion chamber 4 like an inhalation-of-air line, in order for air to decrease comparatively (oxygen density), a fuel maximum temperature is stopped low and reduction of NOx also comes to be obtained effectively.

[0025] Drawing 4 expresses another operation gestalt and it has the fuel supply system 7 which supplies high-pressure fuel gas (CNG), the air supply equipment 8 which supplies high-pressure air, the gas transfer unit 10 which supplies the high-pressure fluid (inert gas in this case) of further others, and \*\*. Supply path 7a of a fuel, supply path 8a of air, and supply path 10a of inert gas are connected to one injector 6a in juxtaposition, and solenoid-valve 9a which opens and closes these supply paths 7a, 8a, and 10a is installed inside the interior of injector 6a (in order to stop the residue of fuel gas, air, and inert gas \*\* to the minimum).

[0026] Although not illustrated, it has a means to detect an engine crank angle, a means to control the change of solenoid-valve 9a based on this detecting signal, and \*\*. and as for solenoid-valve 9a, air is injected from injector 6a at the predetermined period after fuel injection (air-injection period) so that fuel gas may be injected from injector 6a like drawing 5 at the predetermined period (fuel fuel injection period) of a compression stroke -- as -- like an inhalation-of-air line -- from -- it is alike and is controlled so that inert gas is injected by the fuel injection of a compression stroke from injector 6a between everywhere commuter's tickets.

[0027] By one injector 6a, the high-pressure fluid (air and inert gas) with which plurality besides fuel gas differs can be injected at a predetermined period, respectively. Air is injected after injection of fuel gas, and since mixing with a fuel and air is promoted by churning operation of the injection, in the engine which uses the weak gas of the accomplishment force for a fuel, and performs compression ignition, the improvement in engine power and reduction of HC and CO are obtained according to it. moreover -- like an inhalation-of-air line -- from -- in order for air to decrease comparatively (oxygen density), a combustion maximum temperature is low stopped by injection of

the inert gas which attains to the fuel injection of a compression stroke, and NOx is also effectively reduced.

[0028] In the case of drawing 1 and drawing 4, it is based on one injectors 6 and 6a, but as long as allowances are in the surroundings of a combustion chamber 4, the injector of dedication linked to each of each charging line (in drawing 1, it sets to supply path 7a of fuel gas, supply path 8a of air, and drawing 4, and they are supply path 7a of fuel gas, supply path 8a of air, and supply path 9a of inert gas) may be arranged.

---

[Translation done.]

**\* NOTICES \***

JPO and NCIPPI are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

**DESCRIPTION OF DRAWINGS**

---

[Brief Description of the Drawings]

[Drawing 1] It is an outline block diagram showing the operation gestalt of this invention.

[Drawing 2] Similarly it is an operation explanatory view.

[Drawing 3] Similarly it is an operation explanatory view.

[Drawing 4] It is an outline block diagram showing another operation gestalt.

[Drawing 5] It is the property Fig. which similarly explains the contents of control of a solenoid valve.

[Description of Notations]

3 Piston

4 Combustion Chamber

6 6a Injector

7 Fuel Supply System

7a Fuel-supply path

8 Air Supply Equipment

8a Air supply path

9 9a Solenoid valve

---

[Translation done.]

## \* NOTICES \*

JPO and NCIPI are not responsible for any damages caused by the use of this translation.

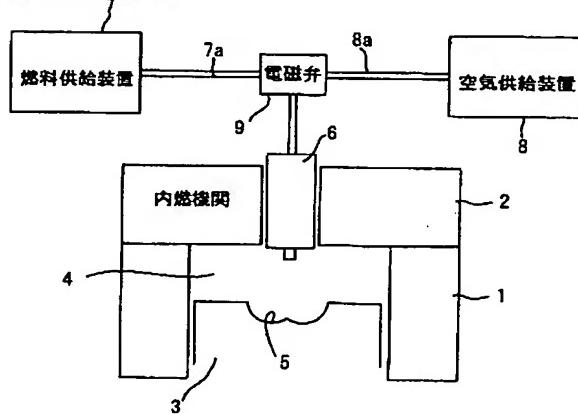
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

---

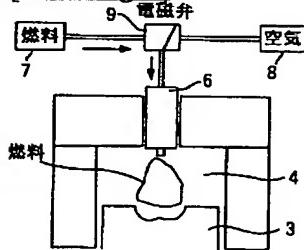
## DRAWINGS

---

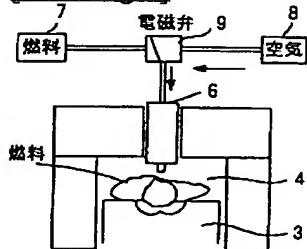
[Drawing 1]



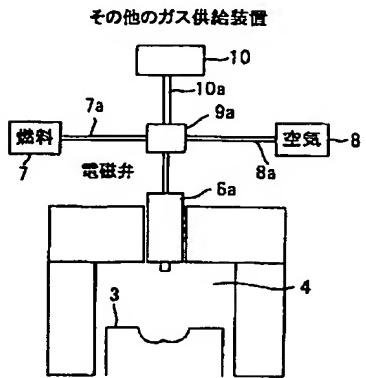
[Drawing 2]



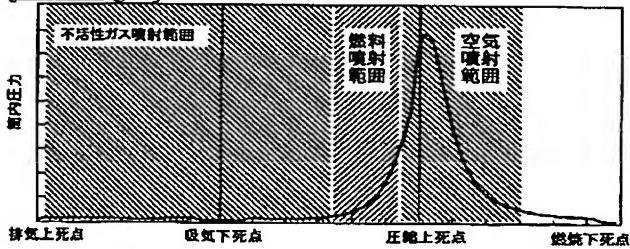
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

(19)日本国特許庁 (JP)

(12)公開特許公報 (A)

(11)特許出願公開番号

特開2002-38955

(P 2002-38955 A)

(43)公開日 平成14年2月6日(2002.2.6)

(51) Int.Cl.<sup>7</sup>

F02B 23/02  
1/12  
43/00  
F02D 19/02  
19/10

識別記号

F I  
F02B 23/02  
1/12  
43/00  
F02D 19/02  
19/10

テーマコード (参考)  
K 3G023  
3G092  
A 3G301  
D

審査請求 未請求 請求項の数 7 O L (全 5 頁) 最終頁に続く

(21)出願番号

特願2000-221824 (P 2000-221824)

(22)出願日

平成12年7月24日 (2000.7.24)

(71)出願人 000003908

日産ディーゼル工業株式会社  
埼玉県上尾市大字毫丁目1番地

(72)発明者 本城 史隆

埼玉県上尾市大字毫丁目1番地 日産ディ  
ーゼル工業株式会社内

(74)代理人 100075513

弁理士 後藤 政喜 (外1名)

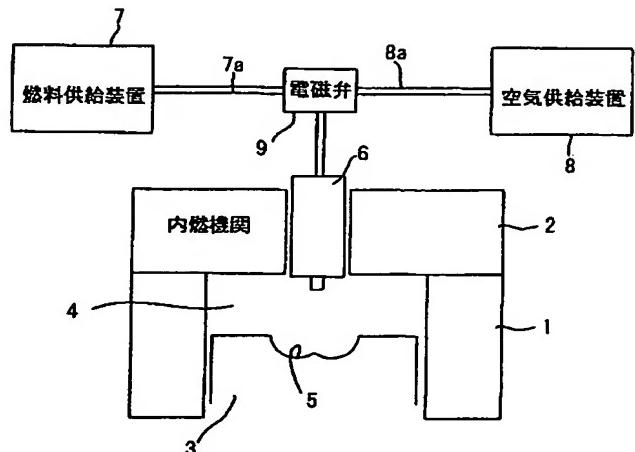
最終頁に続く

(54)【発明の名称】筒内噴射式エンジン

(57)【要約】

【課題】燃料に貫徹力の弱いガスを用いて圧縮着火を行う筒内噴射式エンジンにおいても、噴射燃料と空気との混合を有効に促進できるようにする。

【解決手段】高圧流体(空気)の供給装置8を設けると共に、1つのインジェクタ6に燃料の供給通路7aと高圧流体の供給通路8aを並列的に接続する一方、これらの供給通路7a, 8bをクランク角に応じて開閉する手段9を設ける。



## 【特許請求の範囲】

【請求項1】燃料のインジェクタを備える筒内噴射式エンジンにおいて、燃焼室の噴射燃料に空気または可燃ガスを噴射するインジェクタを設けたことを特徴とする筒内噴射式エンジン。

【請求項2】燃料のインジェクタを備える筒内噴射式エンジンにおいて、燃焼室に不活性ガスを噴射するインジェクタを設けたことを特徴とする筒内噴射式エンジン。

【請求項3】燃料のインジェクタを備える筒内噴射式エンジンにおいて、高圧流体の供給装置を設けると共に、1つのインジェクタに燃料の供給通路と高圧流体の供給通路を並列的に接続する一方、これらの供給通路をクランク角に応じて開閉する手段を設けたことを特徴とする筒内噴射式エンジン。

【請求項4】高圧流体として空気または可燃ガスを用いたことを特徴とする請求項3に記載の筒内噴射式エンジン。

【請求項5】高圧流体として不活性ガスを用いたことを特徴とする請求項3に記載の筒内噴射式エンジン。

【請求項6】燃料のインジェクタを備える筒内噴射式エンジンにおいて、複数の異なる高圧流体を個別的に供給する装置を設けると共に、1つのインジェクタに異なる高圧流体の各供給通路を燃料の供給通路と並列的に接続する一方、これらの供給通路をクランク角に応じて開閉する手段を設けたことを特徴とする筒内噴射式エンジン。

【請求項7】複数の異なる高圧流体として、空気または可燃ガスと、不活性ガスと、を用いたことを特徴とする請求項6に記載の筒内噴射式エンジン。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】この発明は、燃料の噴射弁を備える筒内噴射式エンジンに関する。

## 【0002】

【従来の技術】火花点火を行う筒内噴射式エンジンにおいて、成層燃焼用の噴射弁（インジェクタ）と、均一燃焼用の噴射弁と、を燃焼室に点火プラグやスキッシュエリアとの関係からレイアウト（配置）したものがある（特開平7-247841号）。また、火花点火を行う筒内噴射式エンジンにおいて、成層燃焼の可能な運転領域を広げるため、燃焼室の吸気弁側の側壁に配置される燃料の噴射弁と、これに対向する排気弁側の側壁に配設される高圧空気の噴射弁と、を設けると共に、これらの噴射する燃料噴霧および高圧空気が周囲へ拡散するのを抑えながら、燃料室の中央部に位置する点火プラグの下方で衝突するように案内するガイド溝をピストン頂面に形成したものがある（特開平10-331642号）。

## 【0003】

【発明が解決しようとする課題】筒内噴射式エンジンにおいて、圧縮着火を行う場合、燃料の噴射圧を相当に高

く設定しないと、燃焼室に噴射燃料が拡散されず、圧縮上死点付近で着火するようになるが、空気との混合が十分でないため、エンジンの出力低下や排気エミッション（HC, COなど）の悪化を来たしやすいという不具合が考えられる。とくに燃料がガス（たとえば、CNG）の場合、噴射燃料のピストン頂面などに衝突する貫徹力が弱く、燃焼室の一部分に噴射燃料が濃く固まりやすいのである。

【0004】この発明は、このような問題点を改善するための有効な対策手段の提供を目的とする。

## 【0005】

【課題を解決するための手段】第1の発明では、燃料のインジェクタを備える筒内噴射式エンジンにおいて、燃焼室の噴射燃料に空気または可燃ガスを噴射するインジェクタを設けたことを特徴とする。

【0006】第2の発明では、燃料のインジェクタを備える筒内噴射式エンジンにおいて、燃焼室に不活性ガスを噴射するインジェクタを設けたことを特徴とする。

【0007】第3の発明では、燃料のインジェクタを備える筒内噴射式エンジンにおいて、高圧流体の供給装置を設けると共に、1つのインジェクタに燃料の供給通路と高圧流体の供給通路を並列的に接続する一方、これらの供給通路をクランク角に応じて開閉する手段を設けたことを特徴とする。

【0008】第4の発明では、第3の発明における、高圧流体として空気または可燃ガスを用いたことを特徴とする。

【0009】第5の発明では、第3の発明における、高圧流体として不活性ガスを用いたことを特徴とする。

【0010】第6の発明では、燃料のインジェクタを備える筒内噴射式エンジンにおいて、複数の異なる高圧流体を個別的に供給する装置を設けると共に、1つのインジェクタに異なる高圧流体の各供給通路を燃料の供給通路と並列的に接続する一方、これらの供給通路をクランク角に応じて開閉する手段を設けたことを特徴とする。

【0011】第7の発明では、第6の発明における、複数の異なる高圧流体として、空気または可燃ガスと、不活性ガスと、を用いたことを特徴とする。

## 【0012】

【発明の効果】第1の発明では、空気または可燃ガスの噴射により、燃焼室の噴射燃料が攪拌され、燃料と空気との混合が促進されるため、燃料が貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいても、エンジン出力の向上およびHC, COの低減が得られる。また、可燃ガスの場合、火炎の伝播も促進される。

【0013】第2の発明では、燃焼室の噴射燃料に不活性ガスを噴射すると、燃焼室の噴射燃料が不活性ガスの噴射に攪拌され、燃料と空気との混合が促進されるため、燃料が貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいても、エンジン出力の向上およびHC, C

○の低減が得られる。燃料噴射前の吸気行程に不活性ガスを噴射すると、空気の割合（酸素濃度）が減るため、燃焼最高温度が低く抑えられ、NO<sub>x</sub>の発生も低減される。

【0014】第3の発明では、1つのインジェクタにより、燃料のほか、高圧流体を噴射できる。燃焼室の噴射燃料に高圧流体を噴射すると、噴射燃料が高圧流体の噴射に攪拌され、空気との混合が促進されるため、燃料が貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいても、エンジン出力の向上およびHC, COの低減が得られる。

【0015】第4の発明においては、高圧の空気または可燃ガスが燃料室の噴射燃料に噴射されると、その噴射の攪拌作用により、燃料と空気との混合が促進されるため、燃料が貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいても、エンジン出力の向上およびHC, COの低減が得られる。可燃ガスの噴射による場合、火炎の伝播も促進される。

【0016】第5の発明においては、燃焼室の噴射燃料に不活性ガスが噴射されると、燃焼室の噴射燃料が不活性ガスの噴射に攪拌され、燃料と空気との混合が促進されるため、燃料が貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいても、エンジン出力の向上およびHC, COの低減が得られる。燃料噴射前の吸気行程に不活性ガスが噴射されると、空気の割合（酸素濃度）が減るため、燃焼最高温度が低く抑えられ、NO<sub>x</sub>の発生も低減される。

【0017】第6の発明では、1つの噴射弁により、燃料のほか、複数の異なる高圧流体を噴射できる。燃料噴射後に噴射する高圧流体と、燃料噴射前に噴射する高圧流体を設定すると、燃料噴射後に噴射する高圧流体により、燃料と空気との混合が促進される一方、燃料噴射前に噴射する高圧流体により、運転状態に適合する燃焼室の雰囲気が得られる。

【0018】第7の発明においては、燃料噴射後に空気または可燃ガスが噴射されると、その噴射の攪拌作用により、燃料と空気との混合が促進されるため、燃料が貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいても、エンジン出力の向上およびHC, COの低減が得られる。燃料噴射前の吸気行程に不活性ガスが噴射されると、空気の割合（酸素濃度）が減るため、燃焼最高温度が低く抑えられ、NO<sub>x</sub>の発生も低減される。

【0019】

【発明の実施の形態】図1は圧縮着火を行う筒内噴射式エンジンへの実施形態を表すものであり、1はシリンダーブロック、2はシリンダーヘッド、3はこれらと共に燃焼室4を構成するピストン、を示す。ピストン3頂面の略中央部に窪み部5（キャビティ）が形成され、シリンダーヘッド2に先端の噴口をキャビティ5へ向けてインジェクタ6（噴射弁）が配置される。

【0020】7はインジェクタ6へ高圧の燃料ガス（CNG）を供給する燃料供給装置であり、このエンジンにおいては、高圧の空気をインジェクタ6へ供給する空気供給装置8が備えられる。インジェクタ6に燃料の供給通路7aと並列的に空気の供給通路8aが接続され、これらの供給通路7a, 8aを開閉する電磁弁9が介装される。

【0021】電磁弁9は、圧縮行程の所定期間（燃料噴射期間）にインジェクタ6から燃料ガスが噴射されるよう、燃料噴射後の所定期間（空気噴射期間）にインジェクタ6から空気が噴射されるよう、に制御される（図5、参照）。そのため、図示しないが、エンジンのクラクション角を検出する手段と、この検出信号に基づいて電磁弁9の切り替えを制御する手段と、が備えられる。なお、電磁弁9は、便宜的にインジェクタ6と別体に図示するが、燃料ガスおよび空気の残量を最小限に抑えるため、インジェクタ6の内部において、噴口の極く間近に収装される。

【0022】このような構成により、エンジンのクラクション角に応じて、燃料噴射期間にインジェクタ6から燃料ガスが燃焼室4の吸入空気に噴射され、空気噴射期間にインジェクタ6から空気が噴射される。インジェクタ6から噴射される燃料ガスは、ピストン3頂面に衝突する貫徹力が弱く、図2のように燃焼室4の中央部に濃く固まりやすいが、この燃料ガスの固まりに空気がインジェクタ6から噴射されるので、図3のようにその空気噴射の攪拌作用により、燃料ガスと空気との混合が効率よく促進される。したがって、良好な拡散燃焼が得られるようになり、エンジン出力の向上およびHC, COの低減が図れるのである。

【0023】空気供給装置8において、空気の代わりに高圧の可燃ガスをインジェクタ6に供給すると、可燃ガスの噴射により、燃料ガスと空気との混合が促進され、圧縮着火およびその火炎伝播も促進される。高圧の液体（可燃性を備える）を使用すると、液体の噴射は、噴霧の貫徹力が強く、既述の効果をさらに高めることが可能となる。

【0024】空気の代わりに不活性ガスを使用する場合、燃料ガスの固まりに不活性ガスを噴射すると、その噴射の攪拌作用により、燃料ガスと空気との混合が促進される。また、吸気行程の燃焼室4に不活性ガスを噴射すると、空気の割合（酸素濃度）が減るため、燃焼最高温度が低く抑えられ、NO<sub>x</sub>の低減も有効に得られるようになる。

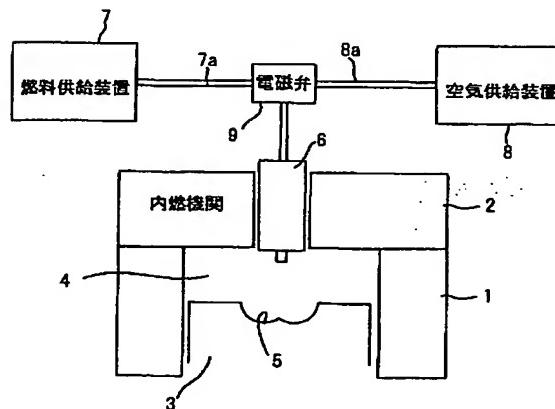
【0025】図4は別の実施形態を表すものであり、高圧の燃料ガス（CNG）を供給する燃料供給装置7と、高圧の空気を供給する空気供給装置8と、さらに他の高圧流体（この場合、不活性ガス）を供給するガス供給装置10と、が備えられる。1つのインジェクタ6aに燃料の供給通路7aと空気の供給通路8aと不活性ガスの

供給通路 10 a が並列的に接続され、これらの供給通路 7 a, 8 a, 10 a を開閉する電磁弁 9 a が、(燃料ガス、空気、不活性ガス、の残量を最小限に抑えるため) インジェクタ 6 a の内部に収装される。

【0026】図示しないが、エンジンのクランク角を検出する手段と、この検出信号に基づいて電磁弁 9 a の切り替えを制御する手段と、が備えられる。そして、電磁弁 9 a は図 5 のようにインジェクタ 6 a から圧縮行程の所定期間(燃料噴射期間)に燃料ガスが噴射されるよう、燃料噴射後の所定期間(空気噴射期間)にインジェクタ 6 a から空気が噴射されるよう、吸気行程から圧縮行程の燃料噴射に至る所定期間にインジェクタ 6 a から不活性ガスが噴射されるよう、に制御される。

【0027】1つのインジェクタ 6 a により、燃料ガスのほか、複数の異なる高圧流体(空気と不活性ガス)をそれぞれ所定期間に噴射できるのである。燃料ガスの噴射後に空気が噴射され、その噴射の攪拌作用により、燃料と空気との混合が促進されるため、燃料に貫徹力の弱いガスを用いて圧縮着火を行うエンジンにおいて、エンジン出力の向上および HC, CO の低減が得られる。また、吸気行程から圧縮行程の燃料噴射に及ぶ不活性ガスの噴射により、空気の割合(酸素濃度)が減るため、燃焼最高温度が低く抑えられ、NO<sub>x</sub> も有効に低減される。

【図 1】



【0028】図 1 および図 4 の場合、1つのインジェクタ 6, 6 a に依拠するが、燃焼室 4 の回りに余裕があれば、各供給配管(図 1 においては、燃料ガスの供給通路 7 a と空気の供給通路 8 a、図 4 においては、燃料ガスの供給通路 7 a と空気の供給通路 8 a と不活性ガスの供給通路 9 a) のそれぞれに接続する専用のインジェクタを配設してもよい。

## 【図面の簡単な説明】

【図 1】この発明の実施形態を表す概要構成図である。

【図 2】同じく作用説明図である。

【図 3】同じく作用説明図である。

【図 4】別の実施形態を表す概要構成図である。

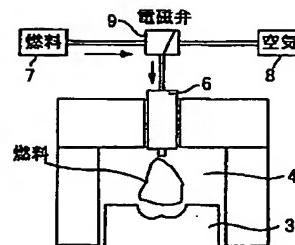
【図 5】同じく電磁弁の制御内容を説明する特性図である。

## 【符号の説明】

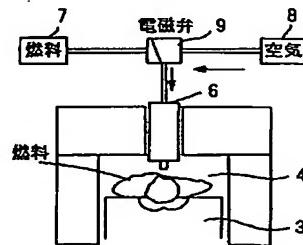
- |        |        |
|--------|--------|
| 3      | ピストン   |
| 4      | 燃焼室    |
| 6, 6 a | インジェクタ |
| 7      | 燃料供給装置 |
| 7 a    | 燃料供給通路 |
| 8      | 空気供給装置 |
| 8 a    | 空気供給通路 |
| 9, 9 a | 電磁弁    |

20

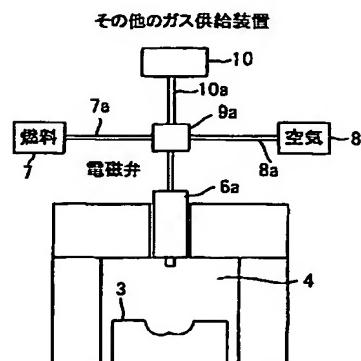
【図 2】



【図 3】

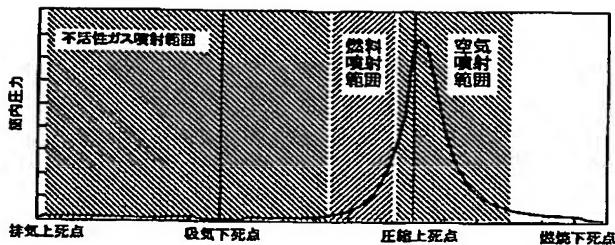


【図 4】



## その他のガス供給装置

【図 5】



## フロントページの続き

(51) Int.C1. <sup>7</sup>	識別記号	F I	マークド <sup>8</sup>	(参考)
19/12		19/12		
41/02	325	41/02	325	K
	351		351	
41/38		41/38		Z
F02M 21/02		F02M 21/02		L
	301		301	A
			301	R
37/00	341	37/00	341	D

F ターム(参考) 3G023 AA02 AA04 AA05 AB05 AC04  
AC07  
3G092 AA06 AB08 AB20 BB18  
DE11S DG09 EA12 FA01  
FA18 HE04Z  
3G301 HA04 HA22 JA01 JA25 JA26  
PB05A PE03A